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ABSTRACT

Conventional experimental research in mental imagery and visualization presents conflicting findings. Naturalistic inquiry offers an alternative approach for the study of mental imagery and problem solving. Paulo Freire, for example, used a naturalistic approach that emphasized active involvement in learning. Imagery can play an important role in learning and can be applied directly in the classrooom. A study is planned to have high school students apply mental imagery in a college reading course and middle school students in a science course. The research on mental imagery and problem solving will involve three basic activities: learning to visualize; using internal and external images to solve problems; and using mental rehearsal to conduct science experiments or take tests in a college reading course. Experimental research is limited in documenting comprehensively the imagery process and subsequent learning behavior. A well-thought out research plan involving both experimental and naturalistic methodologies is the best approach. This paper shares some activities for possible research with the mental imagery process that involves participation by students in a natural setting. Fifteen references are listed. (LMM)

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The Use of Mental Imagery in the Problem Solving Process

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ABST::Flashes of insight or mental leaps are commonly associated with problem solving. THis phenomenon requires careful naturalitic methodology with a comprehensive approach that investigates the dynamics of a situation to illuminate such factors as prior knowledge, motivation, internal and external imagery, perseverance, executive processes and provlem-solving approaches. It is the belief of this author that ex post facto research or experimental research does not allow for the complexity and richness of the interactions inherent in mental imagery and the problem solving processes. When I attempted to investagete how students solved problems, I found that they had verbalized, visualized, added and subtracted information, and recalled past experiences. Students made internal representations of the puzzles presented to them and then used these internal representations for sorting through information, acting out situations, rehearsing solutions and keeping track of deicisons made in the problem solving process. STudents also made exxternal representations of their internal representations. THe external representations were symbols of the internal processing and provided a record of decisions made, of knowledge discovered and of solutions presented. These kinds of external representations have the potential to become records of thought to share with others in the class; therefore, I felt it important to stress to

the students the need for externally representing their thoughts on the instruments provided. They could then use these external reprsentations to share with others the thinking process involved in solving various problems. After explanation of visual rehearsal, students had the opportunity to experience the process. Visual rehearsal, an aspect of mental imagery, is the controlled and conscious act of visualizing situations, people and behavior for planning for the future. A student might visualize the important procedures in a difficult task before actually performing that task. Results showed that visual rehearsal helps the individual to gain insight and develop problem solving schemas. With the results in mind, I developed several instruments containing visual and verbal problems to give training in the use of visual rehearsal and mental imagery. (Author)

Abstract

Flashes of insight or mental leaps are commonly associated with problem solving. This phenomenon requires careful naturalitic methodology with a comprehensive approach that investigates the dynamics of a situation to illuminate such factors as prior knowledge, motivation, internal and external imagery, perseverance, executive processes and problem-solving approaches. It is the belief of this author that ex post facto research or experimental research does not allow for the complexity and richness of the interactions inherent in mental imagery and the problem solving processes.

When I attempted to investigate how students solved problems, I found that they had verbalized, visualized, added and subtracted information, and recalled past experiences. Students made internal representations of the puzzles presented to them and then used these internal representations for sorting through information, acting out situations, rehearsing solutions and keeping track of decisions made in the problem solving process. Students also made external representations of their internal representations. The external representations were symbols of the internal processing and provided a record of decisions made, of knowledge discovered and of solutions presented. These kinds of external representations have the potential to become records of thought to share with others in the class; therefore, I felt it important to stress to the students the need for externally representing their thoughts on the instruments provided. They could then use these external representations to share with others the thinking process involved in solving various problems.

After explanation of visual rehearsal, students had the opportunity to experience the process. Visual rehearsal, an aspect of mental imagery, is the controlled and conscious act of visualizing situations, people and behavior for planning for the future. A student might visualize the important procedures in a difficult task before actually performing that task. Results showed that visual rehearsal helps the individual to gain insight and develop problem solving schemas. With the results in mind, I developed several instruments containing visual and verbal problems to give training in the use of visual rehearsal and mental imagery.

Problem Solving

Technology and change in our society create the need to develop better methods to prepare students for the future. Gregory wrote, "These situations demand different skills: different ways of ordering, handling and seeing objects" (p. 166). No longer are remembering information or even knowing where to find it enough to keep up with our changing world. An innovative approach to help students understand and prepare for the future is the use of mental imagery in problem solving. Problem solving prepares students for changing situations. If we can get students to visualize new situations and help them become better problem solvers, then we are preparing them to take responsibility to meet the challenges of change. Conventional experimental research in visualization and mental imagery presents us with conflicting findings (Guba & Lincoln, 1982, p. 234). Paivio (1971) describes imagery as a photographic reproduction of what the subject sees. This picture taking of the mind's eye, he said, is a one-to-one correspondence to the external event. Penfield (1975) supports this theory with his experiments involving electrical probing of the brains of conscious patients during brain surgery. Patients relived earlier periods or experiences through moving-picture flashbacks. These were not dreams but sequential records of the patients' earlier experiences recorded in the brain. However, Piaget and Inhelden (1971) argue that visual images recorded in the mind depend on the active coding and perceptions of the subject. Yuille and Catchpole (1977) also believe that the active construction of images in the mind plays a role in mental imagery, that more takes place in a person's mind than just a recording of external stimuli. Naturalistic inquiry offers

an alternative approach for the study of mental imagery and problem solving that may provide a more complete explanation.

Rationale for Naturalistic Inquiry

In recent years there has been a growing interest in qualitative or naturalistic methods of research that involve watching, talking to, listening to and participating with subjects in natural settings to gain knowledge of an insight into human learning and behavior. Qualitative research allows for innovative styles and methods in collecting broader explanations of phenomena.

Some critics have said that qualitative (or naturalistic or ethnographic) research methodologies are less scientific and easier to do than quantitative ones. In fact, qualitative researchers have the same concerns about reliability and validity that quantitative researchers have and, far from being easier to do than quantitative research, qualitative research can be more difficult to do if the researchers uphold quality standards. Furthermore, as those in the qualitative camp have charged, the quantitative research methods of control of specific variables and manipulation of other specific variables lead to possible questions about external validity; that is, the findings and conclusions of one experiment with a selected group may not apply to another group. Thus, both methods of research have their limitations. With the limitations of qualitative research in mind, let us look at one method in which students attempted to solve problems through mental imagery.

In his book, Pedagogy of the Oppressed, Paulo Freire (1970) provides an example of this naturalistic approach. Freire used photographs with subjects to encourage dialogue which resulted in action to bring

about conscientization in the minds of oppressed people. Inherent in Freire's approach is the rejection of authoritarian teaching, a feeling of trust acquired through learners' participation, the seeking of truth and a call for cultural expression and action. Perhaps the "human-as-instrument" characteristic that Guba and Lincoln (1982, p. 235) described could be met by adopting the Freire approach.

Freire (1970) developed a philosophy of teaching and learning based on the conviction that every human being is capable of looking critically at his or her world in a dialogical encounter with others. Given an active, participatory role in his or her education a student could perceive his or her reality and be able to deal with that reality with confidence and dignity. The key to the Freire (1970) approach is active, rather than passive, involvement in learning.

Participatory learning through mental imagery and problem solving allows the naturalistic researcher to gain insights into learning behavior by examining students' sketches and discussing them with the students. Students often act out or keep track of their internal thoughts in order to solve the visual puzzles and verbal problems given to them. Students can then use these internal thoughts as data to share with other students. Asking students to become participants in problem solving allows them to learn how each thinks and learn the steps of mental processing that lead to finding solutions to the problems.

Mental Imagery in the Classroom

There is a growing amount of research on visualization, mental imagery and relaxation techniques that is applicable for naturalistic inquiry. Some researchers have used the stress-free and fast learning

technique of Georgi Lozanov called suggestology (Ostrander & Schroeder, 1979). Suggestology is a holistic approach to learning that uses relaxation and concentration techniques, visualization, Baroque music and breathing exercises to learn foreign languages, memorize information, improve self-image, prepare for sports events and solve intellectual and emotional problems. Simonton (1978) in his book, Getting Well Again, describes how positive attitude, relaxation, imagery and exercise are used for treating cancer patients. Simonton (1978) describes how patients form mental pictures of white blood cells killing cancer cells and then carrying them out of the body through the liver and kidneys. In the mind's eye the patients visualized the cancer decreasing in size and the body tissue returning to normal.

Imagery can play an important role in learning. Teaching with visualization can help students design materials, prepare for presentations, understand and retain information and gain control over their learning. Visual thinking involves seeing the external world, making visual representations of that world and using the inner eye or exercising mental imagery. Mental imagery is the ability to create images in the mind to understand, remember and enjoy experiences. We create images in our minds to organize, simplify and explain our experiences. Our interpretations of these experiences are based on our ability to "see" external stimuli and use the "inner eye" to interpret our world.

The value of imagery is that it can be applied directly in the classroom (Fleming & Hutton, 1983). Problems and the act of solving problems are common experiences in the study of all disciplines. In my work, I plan to have high school students apply mental imagery in a college reading course and middle school students to a science

course. In both cases, I plan to introduce mental imagery and problem solving into the existing curriculum and teaching practice with minimum interference with the natural setting of the classroom.

Research Possibilities

The research on mental imagery and problem solving will involve three basic activities: 1. learning to visualize; 2. using images (internal and external) to solve problems; and 3. using mental rehearsal to conduct science experiments or take tests in a college reading course.

I. Learning To Visualize

The subjects will see a slide program as an introduction to visualization and will learn to see and read visual illusions and visual symbols through the slide program. The students will also learn to communicate visually through overhead transparencies, slides, and videotapes they make. This activity is called the "participatory instructional design approach" (Hortin, 1983).

Participatory instructional design means that students become involved in the instructional design process at a more intensive level than is usually the case. Participatory design is a sharing of the thinking processes with the rest of the class -- a "participation" from all who are involved in the experience. The students become their own instructional designers and learn to make their ideas visible with materials provided by the school.

Here are six steps that I will ask my students to use in order to develop materials for the classroom:

1. Affirm you visualization abilities.
2. Assume a relaxed state.
3. Read the problem and data you will treat.
4. Visualize the idea, problem or data (internal representations).
5. Immediately write down, act out, record, sketch, or design the images you see (external representations).
6. Evaluate the instructional materials as a group.

Also, I will discuss with the students the practices and research on mental imagery of the following authors:

Arnheim, R. Visual thinking. Berkeley and Los Angeles: University of California Press, 1969.

Bry, A. Visualization: Directing the movies of your mind. New York: Barnes & Noble Books, 1978.

Edwards, B. Drawing on the right side of the brain. Los Angeles: J. P. Tarcher, 1979.

Gregory, R. L. The intelligent eye. New York: McGraw-Hill Book Company, 1970.

Hortin, J. A. Visual literacy--The theoretical foundations: An investigation of the research, practices and theories (Doctoral dissertation, Northern Illinois University, 1980). Dissertation Abstracts International, 1980. (University Microfilms No. 81-11564)

Ihde, D. Experimental phenomenology: An introduction. New York: G. P. Putnam's Sons, 1977.

McKim, R. H. Experiences in visual thinking. Monterey, California: Brooks/Cole, 1972.

Patten, B. M. Visually mediated thinking: A report of the case of Albert Einstein. Journal of Learning Disabilities, 1973, 6 (7), 15-19; 420.

Samples, R. The metaphoric mind: A celebration of creative consciousness. Reading, Massachusetts: Addison-Wesley Publishing Company, 1976.

Wendt, P. R. The language of pictures. In S. I. Hayakawa (Ed.), The Use and Misuse of Language. Greenwich, Connecticut: Fawcett Publications, 1962.

Whimbey, A. & Whimbey, L.S. Intelligence can be taught. New York: Bantam Books, 1975.

Wileman, R. E. Exercises in visual thinking. New York: Hastings House, 1980.

Williams, L.V. Teaching for the two-sided mind. Englewood Cliffs: Prentice-Hall, 1983.

Finally, a shortened version of the Betts' Questionnaire by Sheehan (1967) will be given to the students. This instrument measures a general ability to image in a number of sensory experiences.

II. Using Images for Problem Solving

In the second activity I will show students how to use images of the mind for problem solving. I want the students to "see" situations, internalize visually the data given, devise a plan for finding the solution and solve the problem.

In the past when I have attempted to investigate how students solved problems, I found they verbalized, visualized, added and subtracted information, and recalled past experiences. Students made internal representations of the puzzles presented to them and then used these internal representations for sorting through information, acting out situations, rehearsing solutions and keeping track of decisions made in the problem solving process. Students also made external representations of their internal representations. The external representations were symbols of the internal processing and provided a record of decisions made, of knowledge discovered and of solutions presented. These kinds of external representations have the potential to become records of thought to share with others in the class; therefore, I felt it important to stress to the students the need for externally representing their

thoughts on the instruments provided. Students could then use these external representations to share with others the thinking process involved in solving various problems. Sample questions from the instruments include the following:

1. If Tom is shorter than Dick, and Harry is taller than Dick, is Tom taller or shorter than Harry? (Albrecht, 1980, p. 43)

2. My house faces the street. If a boy passes by my house walking toward the rising sun, with my house at his right, which direction does my house face? (McKim, 1972, p. 15)

3. A dwarf lives on the twentieth floor of a skyscraper. Every morning he goes into the lift [elevator], pushes the correct button, and is taken to the ground floor; he goes off to work and comes back in the evening. He enters the lift, pushes the button, and goes up to the tenth floor; he then walks up the rest of the stairs. The question is: Why doesn't he go up to the twentieth floor in the lift? (Eysenck, 1966, p. 9)

Most students solved the first question by drawing stick figures and discovering that Tom must be shorter than Harry. The second problem found students drawing a map to arrive the answer (north). The third question caused students to visualize the scene and see that the dwarf cannot reach higher than the tenth button on the elevator.

Another instrument asked students to identify a sequence of figures, perform closure exercises, identify hidden figures, judge distances of lines and move figures in patterns from one position to another.

III. Mental Rehearsal

One aspect of mental imagery that students can find useful is the act of mental rehearsal. Students, like all people, often think about the consequences of certain behavior and decide for or against

that behavior. Since they are accustomed to this process, students can learn to use images or scenes in the mind to help them make decisions and plan their school work. For instance, in my future research I plan to have the science students mentally rehearse their experiments before they perform them and to have the students in the reading course practice mental rehearsal before taking a test.

I believe that experimental research is limited in describing and documenting comprehensively the imagery process and subsequent learning behavior. A well thought out research plan involving both experimental and naturalistic methodologies is the best approach. The intention of this paper was to share some activities for possible research with the mental imagery process that involves participation by students in a natural setting.

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